

**Claimed is:**

1. A system adapted to align digital image data, comprising:  
a plurality of serial data channels, each channel transmitting corresponding serial data,  
the serial data on one serial channel having skew relative to the serial data on other serial  
5 channels;

a serial to parallel converter adapted to convert the serial data on each of the plurality  
of serial data channels into parallel data on corresponding parallel data channels responsive to  
a serial reference clock; and

an alignment circuit adapted to align the parallel data such that no skew is present  
10 between the parallel data on one parallel channel and the parallel data on other parallel  
channels responsive to a pixel clock.

2. The system of claim 1  
wherein the plurality of serial data channels includes a first, second, and third serial  
15 data channels;

wherein the plurality of parallel data channels includes a first, second, and third  
parallel data channels; and

wherein the serial to parallel converter is adapted to convert the serial data on the first,  
second, and third serial channels into corresponding parallel data on the first, second, and  
20 third parallel channels.

3. The system of claim 1 wherein the serial to parallel converter is adapted to  
generate a pixel clock for each parallel data channel and a parallel reference clock.

25 4. The system of claim 3 wherein the alignment circuit comprises:  
a queue circuit adapted to store the parallel data on each of the parallel data channels  
responsive to a corresponding pixel clock; and  
an alignment detection circuit adapted to detect alignment of the parallel data stored in  
the queue circuit responsive to the parallel reference clock.

30 5. The system of claim 4 wherein the queue circuit for each of the parallel data  
channels comprises:

a plurality of FIFO latches, each FIFO latch being adapted to store a word of parallel

data responsive to the corresponding pixel clock;

a compare circuit adapted to generate a match bit for each word of parallel data by monitoring the parallel data for a code;

a register circuit adapted to generate a leading edge signal responsive to the  
5 corresponding pixel clock;

a counter circuit adapted to generate a write pointer responsive to the corresponding pixel clock;

a latch circuit adapted to generate the leading edge pointer by latching the write pointer responsive to the leading edge signal and the corresponding pixel clock; and

10 a multiplexer circuit adapted to receive parallel data stored in the plurality of FIFO latches and output aligned parallel data to a corresponding parallel data channel responsive to a corresponding read pointer.

6. The system of claim 4 wherein each FIFO latch is adapted to store a word of  
15 parallel data responsive to an enable signal and wherein the counter circuit is further adapted to generate the enable signal responsive to the corresponding pixel clock.

7. The system of claim 6 wherein the counter circuit is adapted to generate the enable signal further responsive to a reset signal.

8. The system of claim 5 wherein the code is a blanking code.

9. The system of claim 5 wherein the register circuit is adapted to generate the leading edge signal by comparing a match bit for a presently stored word of parallel data with  
25 a match bit for a previously stored word of parallel data.

10. The system of claim 5 wherein the alignment detection circuit comprises:  
an alignment detection block for each of the parallel data channels, each block  
adapted to generate the corresponding read pointer responsive to the parallel reference clock;  
30 and

a synchronization circuit adapted to receive a leading edge detect signal from each of the alignment detection blocks for each of the parallel data channels and generate a reload read pointer responsive to the parallel reference clock.

11. The system of claim 10 wherein each alignment detection block comprises:  
a shift circuit adapted to receive the corresponding leading edge pointer and generate  
the corresponding read pointer responsive to the reload read pointer;  
5 a latch adapted to receive the leading edge signal and generate a leading edge detect  
signal for the corresponding parallel data channel responsive to the reload read pointer.

12. The system of claim 11 wherein the shift circuit comprises:  
a first multiplexer adapted to select between the corresponding leading edge pointer  
10 and corresponding read pointer responsive to the reload read pointer;  
a shift register adapted to generate a shifted signal by shifting a first multiplexer  
output signal; and  
a second multiplexer adapted to select between the first multiplexer output signal and  
the shifted output signal responsive to the reload read pointer.

13. The system of claim 1 further comprising a decoder adapted to receive the  
aligned parallel data on corresponding parallel channels from the alignment circuit, the  
decoder meeting the digital visual interface specification version 1.0.

14. An alignment circuit receiving input data on a plurality of input data channels  
and generating output data transmissible on a plurality of output data channels, the input data  
on one input data channel having skew relative to the input data on other input data channels,  
comprising:

an alignment detection circuit adapted to generate a plurality of read pointers  
25 corresponding to the plurality of input data channels responsive to a reference clock signal;  
and

a plurality of FIFO circuits corresponding to the plurality of input data channels  
adapted to generate the output data responsive to the plurality of read pointers;

wherein the output data on one output channel has no skew relative to the output data  
30 on other output channels.

15. The alignment circuit of claim 14 wherein the alignment detection circuit  
comprises an alignment detection block for each input data channel, each block adapted to

generate a read pointer for each input data channel responsive to the parallel reference clock.

16. The alignment circuit of claim 15 wherein each alignment detection block comprises:

5 a read pointer generating circuit adapted to receive a corresponding leading edge pointer and generate the corresponding read pointer responsive to a reload read pointer signal;  
a latch adapted to receive a leading edge signal and generate a leading edge detect signal for the corresponding input data channel responsive to the reload read pointer signal.

10 17. The alignment circuit of claim 15 wherein the read pointer generating circuit comprises:

15 a first multiplexer adapted to multiplex between the corresponding leading edge pointer and corresponding read pointer responsive to the reload read pointer;  
a shift circuit adapted to generate a shifted signal by shifting a first multiplexer output signal; and  
a second multiplexer adapted to multiplex between the first multiplexer output signal and the shifted output signal responsive to the reload read pointer.

20 18. The alignment circuit of claim 16 wherein the alignment detection circuit further comprises a feedback circuit adapted to generate the reload read pointer signal responsive to the parallel reference clock.

25 19. The alignment circuit of claim 18 wherein the feedback circuit comprises:  
a logic gate adapted to generate a logic gate signal by logically manipulating leading edge detect signals from each input data channel;  
a plurality of serially connected registers adapted to generate the reload read pointer signal by registering the logic gate signal responsive to the parallel reference clock.

30 20. The alignment circuit of claim 14 wherein each FIFO circuit comprises:  
a plurality of FIFO latches, each FIFO latch adapted to store a word of input data responsive to a corresponding pixel clock;  
a compare circuit adapted to generate a match bit for each word of input data by monitoring the input data for a code;

a register circuit adapted to generate a leading edge signal responsive to the corresponding pixel clock;

a counter circuit adapted to generate a write pointer responsive to the corresponding pixel clock;

5 a latch circuit adapted to generate a leading edge pointer by latching the write pointer responsive to the leading edge signal and the corresponding pixel clock; and

a multiplexer circuit adapted to receive input data stored in the plurality of FIFO latches and output aligned input data to a corresponding input data channel responsive to a corresponding read pointer.

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21. The alignment circuit of claim 20 wherein the code is a DVI blanking code.

22. The alignment circuit of claim 20 wherein the counter circuit is adapted to generate an enable signal responsive to the corresponding pixel clock and a reset signal and wherein each FIFO latch is enabled by the enable signal.

23. The alignment circuit of claim 20 wherein the logic circuit is adapted to generate the leading edge signal by logically manipulating the match bit of a presently stored data word with a match bit of a previously stored data word responsive to corresponding pixel clock.

24. An alignment circuit adapted to align input data transmitted on a corresponding plurality of input data channels, input data on one channel having skew relative to input data on other channels and relative to a data clock, comprising:

25 a plurality of FIFO circuits adapted to receive input data from a corresponding plurality of input data channels, each FIFO circuit comprising:

a plurality of FIFO latches adapted to receive input data from one of the plurality of input data channels responsive to a corresponding pixel clock;

30 a compare circuit adapted to generate a match bit for each word of input data by monitoring the input data for a code;

a register circuit adapted to generate a leading edge signal responsive to the corresponding pixel clock and the match bit;

a counter circuit adapted to generate a write pointer responsive to the

corresponding pixel clock;

a latch circuit adapted to generate a leading edge pointer by latching the write pointer responsive to the leading edge signal and the corresponding pixel clock; and

a multiplexer circuit adapted to receive data stored in the plurality of FIFO latches and output aligned data to a corresponding data channel responsive to a corresponding read pointer;

a plurality of alignment detection circuits corresponding to the plurality of input data channels, each alignment detection circuit comprising:

a first multiplexer adapted to multiplex between the leading edge pointer and read pointer responsive to the reload read pointer;

a shift circuit adapted to generate a shifted signal by shifting a first multiplexer output signal; and

a second multiplexer adapted to multiplex between the first multiplexer output signal and the shifted output signal responsive to the reload read pointer; and

a latch adapted to receive a leading edge signal and generate a leading edge detect signal for the corresponding input data channel responsive to the reload read pointer; and

a feedback circuit adapted to generate the reload read pointer responsive to the leading edge signal generated by each alignment detection circuit for each of the plurality of data channels.

25. A method for aligning image data, comprising:

receiving the data on a plurality of channels, the data on one channel having skew relative to the data on another channel;

storing the data in a plurality of queues;

detecting a valid data transition by checking the data for a predetermined code;

setting a read pointer for each channel to the valid data transition; and

aligning the data by reading the plurality of queues once the read pointers for each of the channels point to a valid data transition.

26. The method of claim 25 wherein receiving the data comprises:

receiving serial data on a plurality of serial channels;

converting the serial data to parallel data; and

providing the parallel data to a plurality of parallel channels.

27. The method of claim 25 wherein storing the data in a plurality of queues includes for each channel storing a word of data in a plurality of FIFO latches responsive to a  
5 corresponding pixel clock.

28. The method of claim 25 wherein detecting a valid data transition comprises scanning each word of data for the code.

10 29. The method of claim 28 wherein detecting a valid data transition comprises:  
storing the code for a previous word of data;  
storing the code for a present word of data; and  
comparing the code for the previous with the code for the present word of data.

15 30. The method of claim 29 wherein detecting a valid data transition includes generating a leading edge signal as a result of comparing the code.

20 31. The method of claim 30 wherein detecting a valid data transition includes:  
generating a write pointer responsive to the pixel clock; and  
generating a leading edge pointer by latching the write pointer responsive to the  
leading edge signal and the pixel clock.

25 32. The method of claim 31 wherein setting the read pointer includes:  
generating a reload read pointer by logically manipulating the leading edge signal  
from each data channel; and  
latching the leading edge pointer responsive to the reload read pointer.

30 33. The method of claim 32 wherein aligning the data by reading the plurality of queues includes:  
multiplexing data from the plurality of FIFO latches to a corresponding data channel responsive to the read pointer, wherein multiplexed data provided to one data channel is aligned relative to other multiplexed data provided to other data channels.